

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, DC 20554**

In the Matter of	)	
	)	
Unlicensed Use of the 6 GHz Band	)	ET Docket No. 18-295
	)	
Expanding Flexible Use in Mid-Band Spectrum	)	GN Docket No. 17-183
Between 3.7 and 24 GHz	)	

**COMMENTS OF WI-FI ALLIANCE**

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June 29, 2020

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Wi-Fi Alliance submits these comments in response to the Further Notice of Proposed Rulemaking (“*Further Notice*”) in the above-referenced proceedings that proposes to expand use of the 5.925-7.125 GHz (“6 GHz”) band by unlicensed devices.<sup>1/</sup> The Commission’s action so far in this proceeding will be transformative for Americans’ ability to get on-line, deploy Internet of Things (“IoT”) devices and otherwise take advantage of all of the technology that relies on the use of unlicensed spectrum.<sup>2/</sup> The changes to the rules proposed in the *Further Notice* will allow even more intense use of the 6 GHz band, meeting the Nation’s ever-expanding connectivity requirements.

**I. INTRODUCTION**

Wi-Fi Alliance®<sup>3/</sup> is a global, non-profit industry association of over 800 leading companies from dozens of countries devoted to seamless interoperability. With technology

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<sup>1/</sup> *Unlicensed Use of the 6 GHz Band*, Report and Order and Further Notice of Proposed Rulemaking, 35 FCC Rcd 3852 (2020) (“*R&O*” and “*Further Notice*” respectively).

<sup>2/</sup> *R&O* ¶¶ 1-4.

<sup>3/</sup> Wi-Fi®, the Wi-Fi logo, the Wi-Fi CERTIFIED logo, Wi-Fi Protected Access® (WPA), WiGig®, the Wi-Fi Protected Setup logo, Wi-Fi Direct®, Wi-Fi Alliance®, WMM®, Miracast®, Wi-Fi CERTIFIED Passpoint®, and Passpoint® are registered trademarks of Wi-Fi Alliance. Wi-Fi CERTIFIED™, Wi-Fi Protected Setup™, Wi-Fi Multimedia™, WPA2™, WPA3™, Wi-Fi CERTIFIED Miracast™, Wi-Fi ZONE™, the Wi-Fi ZONE logo, Wi-Fi Aware™, Wi-Fi CERTIFIED HaLow™, Wi-Fi HaLow™, Wi-Fi CERTIFIED WiGig™, Wi-Fi CERTIFIED Vantage™, Wi-Fi Vantage™, Wi-Fi CERTIFIED TimeSync™, Wi-Fi TimeSync™, Wi-Fi CERTIFIED Location™, Wi-Fi Location™, Wi-Fi

development, market building, and regulatory programs, Wi-Fi Alliance is the organization that enables widespread adoption of Wi-Fi® worldwide by certifying thousands of Wi-Fi products each year. It is also an active participant before the Commission, as well as in other domestic and international proceedings seeking to promote regulatory policies that support the growing Wi-Fi ecosystem.

Last year, Wi-Fi celebrated its twentieth birthday, and few technologies have come so far in so little time. In just over two decades, Wi-Fi has gone from an experiment to a core of the communications ecosystem. Over 30 billion devices now connect to Wi-Fi<sup>4/</sup> across more than 450 million public Wi-Fi hotspots worldwide.<sup>5/</sup> Speeds have soared since the first Wi-Fi standard, 802.11, was introduced in 1997, allowing speeds of 2 Mbps, and are now expected to reach 54.2 Mbps on average globally in 2022.<sup>6/</sup> 59% of Internet traffic is expected to flow through Wi-Fi by 2022.<sup>7/</sup> In addition to the increased amount of data traversing Wi-Fi networks at faster speeds than ever before, new use cases will continue to fill the spectrum designated for unlicensed use. 31 billion IoT devices are expected to be installed worldwide this year, and that

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CERTIFIED Home Design™, Wi-Fi Home Design™, Wi-Fi CERTIFIED Agile Multiband™, Wi-Fi Agile Multiband™, Wi-Fi CERTIFIED Optimized Connectivity™, Wi-Fi Optimized Connectivity™, Wi-Fi CERTIFIED EasyMesh™, Wi-Fi EasyMesh™, Wi-Fi CERTIFIED Enhanced Open™, Wi-Fi Enhanced Open™, Wi-Fi CERTIFIED Easy Connect™, Wi-Fi Easy Connect™, Wi-Fi CERTIFIED 6™ and the Wi-Fi Alliance logo are trademarks of Wi-Fi Alliance.

<sup>4/</sup> 20 Years of Wi-Fi; WI-FI ALLIANCE, at Infographic (last visited June 26, 2020) <https://www.wi-fi.org/discover-wi-fi/20-years-of-wi-fi>.

<sup>5/</sup> *Number of Public Wi-Fi Hotspots Worldwide from 2016 to 2022*, STATISTA (last visited June 26, 2020) <https://www.statista.com/statistics/677108/global-public-wi-fi-hotspots/>.

<sup>6/</sup> *Wi-Fi is 20 Years Old – Here's 20 Milestones in Wi-Fi's History*, CISCO (Sept. 30, 2019) <https://news-blogs.cisco.com/emear/2019/09/30/20-years-of-wi-fi/>.

<sup>7/</sup> CISCO VNI GLOBAL MOBILE DATA TRAFFIC FORECAST, 2017–2022 at 103 (Mar. 2019) [https://www.cisco.com/c/dam/m/en\\_us/network-intelligence/service-provider/digital-transformation/knowledge-network-webinars/pdfs/190320-mobility-ckn.pdf](https://www.cisco.com/c/dam/m/en_us/network-intelligence/service-provider/digital-transformation/knowledge-network-webinars/pdfs/190320-mobility-ckn.pdf).

number will more than double to 75 billion in 2025.<sup>8/</sup> The Commission’s action in the 6 GHz proceeding will help these projections become reality.

The *Further Notice* appropriately proposes to expand the array of benefits that can be delivered by Wi-Fi in the 6 GHz band without disrupting important incumbent operations. Wi-Fi Alliance therefore supports the Commission’s proposals to permit very lower power (“VLP”) operations, increase the power spectral density (“PSD”) limits for low power indoor (“LPI”) devices, permit the use of mobile and transportable standard power access points, and permit higher power fixed point-to-point standard power access points. The Commission should also consider allowing short range client-to-client connectivity, which is needed to enable a host of tetherless use-cases delivering gigabit connectivity, higher video resolutions, lower latency, sensing, and other capabilities.

## **II. THE COMMISSION SHOULD PERMIT VERY LOW POWER OPERATIONS IN THE 6 GHZ BAND**

The Commission proposes to permit VLP devices to operate in the entire 6 GHz band, both indoors and outdoors, without requiring the use of an AFC.<sup>9/</sup> Wi-Fi Alliance strongly supports this proposal. The proposed rules would accommodate seven 160 megahertz channels to support multiple applications that, while now allowed indoors, should also be permitted outdoors.

### **A. VLP Devices in the 6 GHz Band Will Drive Portable Connectivity Innovation.**

The proposed rules will enable applications that would serve the public interest by unlocking numerous innovative use cases. According to a recent Deloitte study, Wi-Fi 6 is a

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<sup>8/</sup> *The IoT Rundown For 2020: Stats, Risks, and Solutions*, SECURITY TODAY (Jan. 13, 2020) <https://securitytoday.com/Articles/2020/01/13/The-IoT-Rundown-for-2020.aspx?Page=2>.

<sup>9/</sup> *Further Notice* ¶ 235.

transformative, “force multiplier for other innovative technologies – including IoT, cloud, and edge computing.”<sup>10/</sup> As described in greater detail below, some of these important use-cases include healthcare,<sup>11/</sup> location, advanced connectivity, automotive,<sup>12/</sup> wireless casting, and augmented- and virtual-reality (“AR/VR”),<sup>13/</sup> with many applications still to be defined.<sup>14/</sup> And a harmonized regulatory framework for affordable and ubiquitous VLP devices is important to market scale and commercial viability.<sup>15/</sup>

***Healthcare VLP Devices.*** VLP devices are already widely deployed for traditional networking throughout the healthcare industry and, as noted below, are even more heavily used now to meet COVID-related applications. Wi-Fi is driving improvements in the flexibility and efficiency of clinical services in healthcare environments, and the industry is poised for 15 percent growth over the next five years in IoT-related healthcare device shipments.<sup>16/</sup> The

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<sup>10/</sup> ENTERPRISES BUILDING THEIR FUTURE WITH 5G AND WI-FI 6, DELOITTE INSIGHTS (2020) [https://www2.deloitte.com/content/dam/insights/us/articles/6664\\_Next-gen-wireless/DI\\_Enterprises-building-their-future.pdf](https://www2.deloitte.com/content/dam/insights/us/articles/6664_Next-gen-wireless/DI_Enterprises-building-their-future.pdf) (“Deloitte Report”).

<sup>11/</sup> *Id.* at 4, 14.

<sup>12/</sup> *Id.* at 20.

<sup>13/</sup> Letter from Apple, *et al.*, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at 2-3 (filed Mar. 18, 2020) (“Mar. 18, 2020 VLP *Ex Parte* Letter”); Cisco, Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2017– 2022, White Paper, at 22 (Feb. 2019); Deloitte Report at 14.

<sup>14/</sup> *See, e.g.*, Letter from Paul Margie, Counsel to Apple, *et al.*, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at Attachment at 2 (filed Mar. 23, 2020) (“Mar. 23, 2020 *Ex Parte* Letter”).

<sup>15/</sup> Letter from Paul Margie, Counsel to Apple, *et al.*, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at Attachment at 7 (noting that in 6 GHz proceedings in the EU, both CEPT and UK Ofcom recently concluded that VLPs operating at 14 dBm (with maximum 1 dBm/MHz PSD) will not create harmful interference when used outdoors).

<sup>16/</sup> *Discover Wi-Fi: Healthcare*, WI-FI ALLIANCE, <https://www.wi-fi.org/discover-wi-fi/healthcare> (last visited June 29, 2020).

healthcare data analytics market alone is expected to grow to \$68 billion by 2020,<sup>17/</sup> with other key growth areas identified as artificial intelligence, wearables, and mobile health. The stage is set for a new era of connected healthcare, both in and outside hospital environments.

Wi-Fi is well-suited to these dynamic environments because it is one of the most trusted, ubiquitous wireless technologies offering high performance connectivity, government-grade WPA3™ security, and support for legacy devices. Beyond hospitals and clinical settings, Wi-Fi also offers a solution to the growing personal health and fitness market. Wi-Fi also helps healthcare information technology managers meet the growing connectivity demands presented by both healthcare staff and patients and their families. Wi-Fi 6E VLP devices offer healthcare facilities a significant increase in coverage, capacity, and efficiency without sacrificing core competencies like interoperability, security and ease of use. Wi-Fi 6E VLP devices can be particularly effective in handling dense environments with hundreds or thousands of devices requiring connectivity simultaneously.

Some healthcare VLP device use cases include:

- Real time patient monitoring systems consisting of physiological body-worn sensors connected to a bedside monitor that forward the acquired data to a central viewer located within the hospital, to electronic medical records (“EMR”) for storage and historical review, and/or to a remote viewer that may be located outside of the hospital (*i.e.*, a doctor’s smartphone).
- Vital signs monitoring systems that consist of physiological sensors connected to a vital signs monitor that forwards the acquired data mainly to an EMR for storage and historical review, but in some less frequent cases, will also forward data to a remote viewer or a central station.
- Intravenous (“IV”) drug delivery control systems where a change in condition requires immediate (*e.g.*, millisecond) action to stop or alter the drug delivery. A handheld or patient management device (which could be a smart phone or

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<sup>17/</sup> Mariana Fernandez, *Frost & Sullivan Reveals 2019 Top Growth Opportunities in Healthcare by Region and Key Sectors*, FROST & SULLIVAN, (Jan. 28, 2019) <https://ww2.frost.com/news/press-releases/frost-sullivan-reveals-2019-top-growth-opportunities-healthcare-region-and-key-sectors/>.

purpose-built device) would be used to directly engage with the IV pump without latency delays on the network.

- Remote patient monitoring systems, consisting of a distributed network of cameras, sensors, and alarms, enable close monitoring of patients requiring constant supervision (e.g., patients that are suicidal, confused, aggressive, or at risk of being hurt from falling).
- COVID and other infectious diseases use cases, where a clinician can remain outside a patient's room but connect directly to a monitoring device in the room with high fidelity data and avoid the process and delay of connecting to the hospital information technology network.
- AR for surgery and other treatment workflows that can benefit from visual guidance and content at the point-of-contact.
- Higher resolution display systems enable projection of video to a larger, higher resolution display co-located in the same room for real-time analysis.
- Access to medical care through real-time video, especially in remote geographies, and access to specialists, such as mental health providers. These use cases enable medical examinations, consultations, advanced instruction, advanced post-care instructions and other critically important applications.

**Location VLP Devices.** Wi-Fi location services deliver high-accuracy location determination capabilities, particularly indoors where other location determination technologies may not be readily available. Location solutions utilizing Wi-Fi 6E-enabled VLPs can deliver increased accuracy to sub one-meter, substantially better power consumption, low-latency estimation, are scalable in venues with high user populations, and provide features that guarantee secure and private operation. These benefits can be available to both users and access point infrastructure providers, enabling a host of proximity-based services. The indoor location services market is predicted to grow from \$6.1 billion in 2020 to \$17 billion by 2025, representing a compound annual growth rate of 22.5 percent.<sup>18/</sup> These services have been fueled

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<sup>18/</sup> *Indoor Location Market by Component (Hardware, Solutions, and Services), Deployment Mode, Organization Size, Technology, Application, Vertical (Retail, Transportation and Logistics, Entertainment), and Region - Global Forecast to 2025*, MARKETS & MARKETS (May 2020), <https://www.marketsandmarkets.com/Market-Reports/indoor-location-market-989.html>.



in 2020 by the staggering 3.5 billion estimated unit smartphone ecosystem.<sup>19/</sup> Business venues for enterprise, finance, retail, health and entertainment are all primarily indoors. Indoor locations are thriving with the opportunity to provide considerable value to these or adjacent businesses. Wi-Fi is well-suited to be the technology of choice for indoor location services because it is already ubiquitous in its deployment across the globe, and provides high-bandwidth data services, which are the primary driver for the market, and each new generation continues to improve performance.

***Advanced Connectivity.*** As Wi-Fi deployments continue their exponential growth, Wi-Fi devices increasingly must operate in congested spectrum environments, in the presence of multiple heterogeneous networks and often with heavily user-loaded access points. With highly localized coverage, Wi-Fi 6E-enabled VLPs will deliver multiple benefits, where they are needed most, such as in airports, train stations, stadiums, malls, classrooms, public transportation and many other high user density environments.

***Automotive.*** Driven by consumer demand, connectivity has become one of the top design priorities in the automotive segment. 6 GHz-enabled VLP devices will support multiple vehicle infotainment, maintenance, tracking, security and other applications. Importantly, greater spectrum availability will significantly facilitate in-vehicle coexistence among multiple unlicensed technologies.

***Wireless Casting.*** Demand for wireless connectivity between content sources and display devices that enable high-performance audio and video rendering continue to increase at a significant rate. VLP access to the 6 GHz band will enable next generation casting to

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<sup>19/</sup> *Number of Smartphone Users Worldwide from 2016 to 2021(in Billions)*, STATISTA (last visited June 26, 2020) <https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/>.

smartphones, tablets, TVs, projectors, and many other devices. Wireless streaming of cloud-based content directly to end-user devices has the potential to revolutionize infotainment for the consumer as well as enterprise environments.

**AR/VR.** VLP devices will support a variety of AR/VR implementations in numerous devices including imaging headsets, headphones, game controllers, keyboards, hearing aids, and a range of other applications. A VLP device class would allow AR/VR applications to go untethered—and even mobile—for the first time, because the 6 GHz band would support energy efficient operations at the high throughputs and low latencies necessary for AR/VR applications without the constraint of a wire.<sup>20/</sup> As members of Wi-Fi Alliance have previously noted, 6 GHz AR/VR capabilities, combined with low latencies and high data rates, would support new critical use cases, from training for life-saving surgeries to assisting blind or low-vision Americans.<sup>21/</sup> VR applications, for example, might allow senior residents in memory care to virtually explore outdoor or cultural destinations and enable new therapies to help patients recover from post-traumatic stress disorder and addiction.<sup>22/</sup>

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<sup>20/</sup> Mar. 18, 2020 VLP *Ex Parte* Letter at 2; *see also* Letter from Paul Margie, Counsel to Apple, *et al.*, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295, GN Docket No. 17-183, at 1 (filed Jan. 31, 2020).

<sup>21/</sup> Mar. 18, 2020 VLP *Ex Parte* Letter at 2; *see also* Jonathan Shieber, *Medivis Gets FDA Approval for Its Augmented Reality Surgical Planning Toolkit*, TECHCRUNCH (May 30, 2019), <https://techcrunch.com/2019/05/30/medivis-gets-fda-approval-for-its-augmented-reality-surgical-planning-toolkit/>; Robin Christopherson, *Three Cool Smart Glasses to Help People Who Are Blind or Have Sight Loss*, ABILITYNET (Apr. 4, 2018), <https://www.abilitynet.org.uk/news-blogs/three-cool-smart-glasses-help-people-who-are-blind-or-have-sight-loss>.

<sup>22/</sup> Mar. 18, 2020 VLP *Ex Parte* Letter at 2; *see also* Katy Read, *Virtual Reality Lets Seniors Travel Without Leaving Home*, STAR TRIBUNE (July 23, 2019), <http://www.startribune.com/virtual-reality-lets-seniors-travel-withoutleaving-home/513120922/?refresh=true>.

The Commission asks about the data rates necessary to enable these applications and the distance over which transmissions will occur.<sup>23/</sup> While the range of applications – and therefore data rates and transmission distances – will be diverse, the following are some examples:

- Rapid content, such as HD video, will operate with ultra-short separation of under 10 centimeters and will have target data rates exceeding 2 Gbps.
- Wireless game consoles and displays supporting bi-directional data between the game console and hand-held controllers will operate at a distance of less than 5 meters and will have target data rates exceeding 1 Gbps.
- Immersive and interactive applications with 360-degree video require latencies as low as 5-20 milliseconds. Low latency drives the need for much higher frames per second (*i.e.*, significantly higher data rates).

**B. The Commission Should Permit VLP Devices to Operate at 14 dBm EIRP and 1 dBm/MHz.**

The Commission seeks comment on the appropriate power level for VLP unlicensed devices in the 6 GHz band.<sup>24/</sup> The Commission should permit VLP devices to operate at 14 dBm EIRP and 1 dBm/MHz – levels that would both protect existing services and allow effective use of the band for VLP operations. As Apple, Broadcom, Facebook, and Google have demonstrated in numerous *ex parte* letters and studies, VLP devices operating either indoors or outdoors would not cause harmful interference unless a long list of unlikely, worst-case conditions occurred simultaneously, and if such rare alignment did occur, the interference would be momentary due to the low-duty cycle and transitory use of VLP devices.<sup>25/</sup> In any case, the Commission may require Transmit Power Control (“TPC”) as a mitigation technique.<sup>26/</sup> TPC will further reduce the interference potential by attenuating the VLP signal by an additional 14 dB.<sup>27/</sup>

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<sup>23/</sup> *Further Notice* ¶ 235.

<sup>24/</sup> *Id.* ¶ 236.

<sup>25/</sup> Mar. 18, 2020 VLP *Ex Parte* Letter at 7-12; Mar. 23, 2020 *Ex Parte* Letter at Attachment at 5.

<sup>26/</sup> *See Further Notice* ¶ 241.

<sup>27/</sup> *Id.* ¶¶ 239, 241, n.617.

As the Commission notes, the *Report and Order* permits low power devices operating *indoors* with 5 dBm/MHz PSD EIRP and a maximum 30 dBm EIRP.<sup>28/</sup> So, VLP devices operating at *even lower power indoors* will have even lower interference potential than the Commission has already found acceptable. Moreover, VLP devices are largely personal area network devices that, especially when operating indoors, will experience more localized clutter and body loss than typical access points.<sup>29/</sup>

The use of VLP devices *outdoors* similarly presents minimal risk of interference to incumbent operations. First, according to estimates, Americans only spend between 2% to 5% of their time outdoors.<sup>30/</sup> And, obviously, most Americans will not continuously use their VLP devices while they are outdoors. Further, the main use of VLP devices outdoors will be during the time periods when fixed service devices enjoy maximum link margins.<sup>31/</sup>

The Commission has already concluded, based on technical studies, that fixed microwave receivers will be protected from harmful interference from unlicensed indoor low power devices in the 6 GHz band.<sup>32/</sup> In reaching that decision, the Commission confirmed values for a set of

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<sup>28/</sup> *R&O* at pg. 9, Table 3, *id.* ¶ 166; *Further Notice* ¶ 231.

<sup>29/</sup> See Letter from Paul Margie, Counsel to Apple, *et al.*, to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at Attachment at 6-7 (filed Dec. 9, 2019).

<sup>30/</sup> U.S. Environmental Protection Agency, 1989 Report to Congress on Indoor Air Quality: Volume 2 at I, EPA/400/1-89/001C (Aug. 1989) <https://nepis.epa.gov/Exe/ZyPDF.cgi/9100LMBU.PDF?Dockey=9100LMBU.PDF> (“People spend approximately 93% of their time indoors, 2% outdoors, and 5% in transit (e.g. car, train, bus)”). See also Trevor Hancock, *Encyclopedia of Public Health - Built Environment*, ENCYCLOPEDIA.COM (June 21, 2020) <http://www.encyclopedia.com/doc/1G2-3404000130.html> (Noting that “[t]he average North American spends approximately 90 percent of the time indoors, 5 percent in cars, and only 5 percent outdoors”).

<sup>31/</sup> *R&O* ¶ 143 (“Temporal separation between when multipath fading is most likely to occur and when Wi-Fi devices are heavily used means there is low probability that Wi-Fi transmissions will overlap with multipath fading events.”).

<sup>32/</sup> *Id.* ¶ 112.

technical parameters to be used in technical interference studies.<sup>33/</sup> As shown in Table 1 below, applying these parameter values to compute the I/N ratio confirms that VLP devices operating across the 6 GHz band will interfere even less than previously approved low power devices.

**Table 1: Computation of I/N for VLP Sharing with Microwave Receivers** (bold rows are parameters values confirmed by the Commission<sup>34/</sup>)

	Example 1: VLP at ground level, 30 meters away from microwave receiver	Example 2: VLP within microwave receiver boresight, consistent with “longer distance” scenario; analogous to <i>Report and Order</i> , Table 4
EIRP/BW	14 dBm/80 MHz	14 dBm/80 MHz
PSD	1 dBm/MHz	1 dBm/MHz
<b>Fixed Antenna Gain</b>	<b>37.9 dB</b>	<b>37.9 dB</b>
<b>Antenna Discrimination</b> (assume antenna height at 30 meters)	-58.56 dB Discrimination at 45 deg off boresight <sup>35/</sup>	<b>-1.5 dB</b>
<b>VLP/FS Antenna Mismatch</b>	<b>-5 dB</b>	<b>-5 dB</b>
Body Loss=4 dB <sup>36/</sup>	-18.0 dB	-18.0 dB

<sup>33/</sup> *Id.* ¶ 128.

<sup>34/</sup> *Id.* Table 4 and ¶ 128.

<sup>35/</sup> Letter from Cheng-yi Liu and Mitchell Lazarus, Fletcher, Heald & Hildreth, P.L.C., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 17-183, at 17, Fig. 1 (Mar. 13, 2018).

<sup>36/</sup> *Report ITU-R M.2292-0, Characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses*, International Telecommunication Union (Dec. 2013) [https://www.itu.int/dms\\_pub/itu-r/opb/rep/R-REP-M.2292-2014-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2292-2014-PDF-E.pdf). Also, movement of persons and objects – known as body shadowing – causes temporal variations of the propagation characteristics. Outdoor VLP devices will encounter significant body shadowing from vehicle and pedestrian traffic, resulting in a significant increase in attenuation coefficient further reducing propagation of VLP signals and, thereby, their interference potential. Increased use of VLP devices outdoors may be expected during rush hour, but that is also when there is higher car and/or pedestrian traffic further attenuating interference potential. See Rec. ITU-R P.1411-9, *Propagation data and prediction methods for the planning of short-range outdoor radiocommunication systems and radio local area networks in the frequency range 300 MHz to 100 GHz*, at 4.1.2 (June 2017) [https://www.itu.int/dms\\_pubrec/itu-r/rec/p/R-REC-P.1411-9-201706-I!!PDF-E.pdf](https://www.itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.1411-9-201706-I!!PDF-E.pdf).

TPC=-14 dB <sup>37/</sup>		
<b>Clutter</b>	0 dB	<b>-18.4 dB (using ITU-R P.452 clutter model)</b>
<b>Path Loss</b>	-81.6 dB (Free Space)	<b>-120.12 dB (ITM P2P model)</b>
<b>Bandwidth Mismatch</b>	<b>-4.26 (assuming 80 MHz channels)</b>	<b>-4.26 (assuming 80 MHz channels)</b>
<b>Noise Figure</b>	<b>-3.0 dB</b>	<b>-3.0 dB</b>
<b>Polarization Loss</b>	<b>-3.0 dB</b>	<b>-3.0 dB</b>
<b>Feeder Loss</b>	<b>0 dB</b>	<b>0 dB</b>
Building Entry Loss	0 dB (assume VLP operation outdoors)	0 dB (assume VLP operation outdoors)
Interference (I)	-121.52 dBm	-121.38 dBm
<b>Noise Floor (N)</b>	<b>-99 dBm</b>	<b>-99 dBm</b>
I/N	-22.42 dB	-22.38 dB

This analysis confirms that a -8 dBm/MHz PSD EIRP is unnecessarily restrictive for VLP operations. In fact, numerous studies conducted recently by the European regulators demonstrate that the appropriate PSD EIRP limit for VLP devices is in the 1 dBm/MHz to 10 dBm/MHz range.<sup>38/</sup> In considering the appropriate PSD EIRP limit for VLP devices, the

<sup>37/</sup> See Letter from Paul Margie, Counsel to Apple, *et al.*, to Marlene Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at 4 (Nov. 12, 2019); *see also Report ITU-R M.2292-0, Characteristics of terrestrial IMT-Advanced systems for frequency sharing/interference analyses*, International Telecommunication Union, at 7-8 (Dec. 2013) [https://www.itu.int/dms\\_pub/itu-r/opb/rep/R-REP-M.2292-2014-PDF-E.pdf](https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2292-2014-PDF-E.pdf).

<sup>38/</sup> Draft ECC Decision (20)XX On the Harmonized Use of the Frequency Bands 5945 to 6425 MHz for Implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLAN) [https://cept.org/Documents/wg-fm/59176/temp-014rev1\\_draft-ecc-decision-on-was-rlan-at-6-ghz-for-pc](https://cept.org/Documents/wg-fm/59176/temp-014rev1_draft-ecc-decision-on-was-rlan-at-6-ghz-for-pc); *See also* UK Ofcom Consultation: Improving Spectrum Access for Wi-Fi Spectrum Use in the 5 and 6 GHz bands, at 64 (Jan. 2020) [https://www.ofcom.org.uk/\\_\\_data/assets/pdf\\_file/0038/189848/consultation-spectrum-access-wifi.pdf](https://www.ofcom.org.uk/__data/assets/pdf_file/0038/189848/consultation-spectrum-access-wifi.pdf).

Commission should take into account the need for international harmonization for highly portable and ubiquitously deployed VLP devices.<sup>39/</sup>

**C. Use of Contention-Based Protocols Will Further Prevent Harmful Interference to Both Unlicensed and Licensed Devices.**

The Commission asks if it should require contention-based protocols for VLP devices, as it has for low power indoor devices.<sup>40/</sup> Contention-based protocols such as Wi-Fi's carrier sense multiple access with collision avoidance, already enable co-existence of multiple unlicensed device types. The same contention-based protocols used by unlicensed devices to ensure that they do not interfere with one another will reduce interference potential to incumbent licensed operations. The IEEE specification for Wi-Fi, for example, requires energy detection at -62 dBm/20 MHz. Wi-Fi Alliance members report that their implementation can sense at an even lower threshold to ensure compliance with the IEEE specification. So, in real world implementations, the contention-based protocol is even more effective in protecting incumbent operations.<sup>41/</sup> Accordingly, currently employed contention-based protocols would effectively augment protection of the licensed services, and Wi-Fi Alliance supports requiring such protocols for VLP implementations.

Because of the short range of both VLP and UWB devices in particular, as well as the nature of UWB operations, much of the interference potential between the two unlicensed

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<sup>39/</sup> See Best Practices for National Spectrum Management, FCC, <https://www.fcc.gov/general/best-practices-national-spectrum-management> (last visited June 26, 2020) (Item 10: "Harmonizing, as far as practicable, effective domestic and international spectrum policies, including of radio-frequency use").

<sup>40/</sup> *Further Notice* ¶ 237.

<sup>41/</sup> Letter from Apple, *et al.* to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at 1, 5 (Mar. 20, 2020); Letter from Christopher Szymanski, Director, Product Marketing and Government Affairs, Wireless Communications and Connectivity Division, Broadcom Inc., to Ms. Marlene H. Dortch, Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183 (filed Feb. 28, 2020).

applications will be confined to particular locations under the control of a single entity. The Commission need not protect entities from causing interference to their own operations. Doing so would also violate the fundamental principle of unlicensed operations that all Part 15 devices operate on a “sufferance” basis.<sup>42/</sup>

### **III. HIGHER POWER SPECTRAL DENSITY SHOULD BE PERMITTED FOR LOW POWER INDOOR OPERATIONS**

The Commission seeks comment on increasing the PSD for LPI devices to 8 dBm/MHz with a maximum permissible EIRP of 33 dBm when a device uses a bandwidth of 320 megahertz in the U-NII-5 through U-NII-8 bands.<sup>43/</sup> Wi-Fi Alliance supports increasing the PSD from 5 dBm/MHz to 8 dBm/MHz for LPI devices.<sup>44/</sup> Sufficient PSD for LPI devices is necessary to ensure that American consumers realize the full benefits of the 6 GHz band. Operations at higher PSD can effectively deliver multi-gigabit Wi-Fi throughout the 6 GHz band to homes and businesses.<sup>45/</sup> As the Commission notes and stakeholders have explained, higher permitted power levels would be useful for indoor operations of numerous use cases.<sup>46/</sup> Studies and

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<sup>42/</sup> *In the Matter of Revision of Part 15 of the Commission’s Rules Regarding Ultra-Wideband Transmission Systems*, Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, 18 FCC Rcd 3857, ¶ 119 n.290 (2003); *see also* Letter from Christopher Szymanski, Director, Product Marketing and Government Affairs, and Gabriel Desjardins, Director, Product Marketing, Wireless Communications and Connectivity Division, Broadcom Inc., to Marlene Dortch, Secretary, FCC, ET Docket No. 18-295 (Jan. 15, 2020).

<sup>43/</sup> *Further Notice* ¶ 244-45.

<sup>44/</sup> *See id.*

<sup>45/</sup> *See* Letter from Elizabeth Andrión, Senior Vice President, Regulatory Affairs, Charter Communications, and Rob Alderfer, Vice President of Technology Policy, CableLabs, to Ms. Marlene H. Dortch Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183 (filed Feb. 21, 2020) (“Charter and CableLabs *Ex Parte* Letter”).

<sup>46/</sup> *Further Notice* ¶ 244; *see also, e.g.*, Charter and CableLabs *Ex Parte* Letter at Attachment, at 2 (noting that 30 dBm is essential to enable coverage of homes and businesses to ensure they have access to the benefits of Wi-Fi in 6 GHz, and will pose no risk of harmful interference with an 8 dBm/MHz PSD).



analyses demonstrate that the proposed higher PSD limits will not affect incumbent operations.<sup>47/</sup> Power levels enable the enhanced throughput and capabilities of Wi-Fi 6 to reach beyond one or two rooms without the need for signal extenders or additional equipment. In contrast, reduced PSD below 8 dBm/MHz, will lead to two main problems for consumers and businesses who rely on Wi-Fi. *First*, those consumers and businesses will experience a loss of coverage area. In particular, 5 dBm/MHz reduces coverage range by 31-43%. *Second*, they will experience reduction in throughput in the area that remains covered. A 5 dBm/MHz limit reduces throughput by 53-63%.<sup>48/</sup>

#### **IV. STANDARD POWER ACCESS POINTS SHOULD BE PERMITTED TO BE USED IN MOBILE APPLICATIONS**

The Commission asks whether it should allow standard-power access points, under AFC control, to be used in mobile applications.<sup>49/</sup> Mobile and transportable standard power access points will constitute important use cases in the Wi-Fi ecosystem. Examples of some of those use cases include: 1) mobile industrial clients with uses such as forklifts, top loaders, rail cranes, and tractors; 2) maritime ports with uses such as gantry cranes and transiting and docked harbor ship-to-shore communications; 3) airport gatelink systems; 4) rail uses such as train/subway car-to-car and car-to-trackside mesh; 5) emergency responders for mobile incident command centers

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<sup>47/</sup> See Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, to Ms. Marlene H. Dortch Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183 (filed Dec. 20, 2019); *id.* at Attachment, *6 GHz Low Power Indoor (LPI) Wi-Fi / Fixed Service Coexistence Study* (demonstrating that LPI at 8 dBm/MHz will not cause harmful interference to incumbent fixed service and broadcast auxiliary service links); *see also* Letter from Elizabeth Andrion, Senior Vice President, Regulatory Affairs, Charter Communications, *et al.*, to Ms. Marlene H. Dortch Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183 (filed Jan. 17, 2020); *id.* at Attachment, *Low Power Indoor (LPI) Wi-Fi Will Not Cause Harmful Interference or Impact Availability of 6 GHz Fixed Service (FS) Incumbents* (demonstrating the same).

<sup>48/</sup> See Letter from Rob Alderfer, Vice President of Technology Policy, CableLabs, to Ms. Marlene H. Dortch Secretary, FCC, ET Docket No. 18-295 and GN Docket No. 17-183, at 2 (filed Mar. 30, 2020).

<sup>49/</sup> *Further Notice* ¶ 246.

and temporary surveillance and monitoring; 6) mobile agriculture mesh; 7) repositionable construction data-networks; 8) repositionable mining data-networks; and 9) entertainment venues, stadiums, concert arenas, audio-visual mixing booths, and media tents.

As the Commission proposes, the same technical requirements that apply to fixed standard power access points should apply to mobile and transportable access points.<sup>50/</sup> The Commission should rely on existing white space rules to govern the management of mobile standard power access points,<sup>51/</sup> including the proposal to allow devices to operate on mobile platforms within geo-fenced areas.<sup>52/</sup> As noted in the *White Spaces NPRM*, geo-fenced operations would enhance connectivity, particularly in rural areas, by enabling improved communications on moving vehicles such as school buses and agricultural equipment, and for applications such as monitoring roaming livestock.<sup>53/</sup>

The Commission asks whether it should define a separate device category of mobile and transportable standard-power devices.<sup>54/</sup> There is no need to do so. All standard power devices operating under the control of an AFC system should be treated the same, including with respect to power limits and the bands in which they operate.<sup>55/</sup> Likewise, protection distances should be dependent on use cases and can be managed by the AFC system.<sup>56/</sup> Many mobile standard power

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<sup>50/</sup> *Id.*

<sup>51/</sup> 47 C.F.R. § 15.711(d)-(e).

<sup>52/</sup> *Unlicensed White Space Device Operations in the Television Bands*, Notice of Proposed Rulemaking, 35 FCC Rcd 2101, ¶ 39 (2020) (“We propose to allow white space devices to operate on TV Channels 2-35 on mobile platforms within geo-fenced areas at higher power levels than the rules currently permit for portable devices, and propose to limit such operations to “less congested” areas to limit their potential for causing harmful interference.”) (“*White Spaces NPRM*”).

<sup>53/</sup> *Id.* ¶ 39.

<sup>54/</sup> *Further Notice* ¶ 248.

<sup>55/</sup> *See id.* ¶ 249.

<sup>56/</sup> *See id.*

operations can be addressed through AFC geo-fencing, which will allow an access point to load channel availability information for multiple locations, (*i.e.*, in the vicinity of its current location) and use that information to define a geographic area within which it can operate on the same available channels at all locations. Other applications may require real-time computation, taking into account a mobile access point's speed, trajectory and other factors.

There is no need for the Commission to over-regulate AFC system management of mobile and transportable standard power access points. The Commission's role in AFC system management should be limited to confirming and certifying AFC qualifications. AFCs should be required to demonstrate their capability to manage mobile applications in whatever manner they deem appropriate, consistent with the Commission's rules. Similar to the Commission's proposal for white space device management in a geo-fenced area,<sup>57/</sup> the Commission should limit mobile standard access point use of available channel information for multiple locations if/when it moves closer to the boundary of the geo-fenced area in which the device is operating, or at any point outside that boundary.<sup>58/</sup>

## **V. STANDARD-POWER ACCESS POINTS USED IN FIXED POINT-TO-POINT APPLICATIONS SHOULD BE PERMITTED TO OPERATE WITH HIGHER POWER**

The Commission seeks comment on whether to allow standard-power access points used in fixed point-to-point applications to operate at power levels greater than 36 dBm EIRP.<sup>59/</sup> Wi-Fi Alliance supports this proposal. The Commission has recognized the need to provide wireless Internet service providers additional flexibility for operations in the 5 GHz band to meet the

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<sup>57/</sup> *White Spaces NPRM* ¶ 40.

<sup>58/</sup> *Id.*

<sup>59/</sup> *Further Notice* ¶ 252.

increased demand for internet service due to COVID-19.<sup>60/</sup> Adoption of the Commission's proposals will further support those efforts, relieve some of the congestion in the 5 GHz band, and extend the success of 5 GHz to the 6 GHz band. The technical requirements for higher-power operations in the U-NII-3 5 GHz band have a demonstrated record of success and should apply to the 6 GHz band. Specifically, the Commission should allow fixed point-to-point U-NII-5 and -7 standard power access points to employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.<sup>61/</sup>

## **VI. AFC SYSTEMS SHOULD BE ALLOWED TO ACCOUNT FOR STANDARD-POWER ACCESS POINT ANTENNA DIRECTIVITY**

The Commission asks whether AFC systems should be permitted to take the directivity of a standard-power access point's antenna into account when determining the available frequencies and power levels at a location, rather than assuming an omnidirectional antenna.<sup>62/</sup> Wi-Fi Alliance agrees that they should. In cases where an AFC system is expected to account for the directivity of a standard-power access point transmit antenna, the Commission should require determination of access point antenna orientation and directivity either through professional installation for devices in cases that require antenna orientation, or to be provided automatically by the access point to the AFC system. As the Commission acknowledged in the *Report and Order*, real-world unlicensed device antenna patterns would likely result in less gain toward the horizon.<sup>63/</sup> In fact, in many cases, a standard-power access point antenna will be affixed to a

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<sup>60/</sup> See Press Release, 5.9 GHz Band Boosts Consumer Internet Access during COVID-19 Pandemic, FCC (May 4, 2020) <https://docs.fcc.gov/public/attachments/DOC-364138A1.pdf>; Press Release, FCC Extends Temporary Waivers for Relay Services Rules during Pandemic, FCC (May 14, 2020) <https://docs.fcc.gov/public/attachments/DOC-364356A1.pdf>.

<sup>61/</sup> 47 C.F.R. § 15.407(a)(3).

<sup>62/</sup> *Further Notice* ¶ 254.

<sup>63/</sup> *R&O* ¶ 125.

ceiling or wall, which will further limit its gain contours. And, there is no reason to limit available frequencies by precluding the AFC from taking into account an antenna's orientation and directivity.

Accounting for standard-power access point antenna orientation and directivity, however, should be an optional feature of AFC systems, not a requirement. If the standard-power access point's antenna orientation and directivity is not available, then the AFC system should base its computation on the worst case (*e.g.*, omnidirectional) antenna pattern. The regulations, therefore, should provide AFC system operators and the marketplace with the discretion to balance cost, complexity and other factors in the development of their systems. There is no reason to constrain viable implementations, and the Commission should not impede implementation by unnecessary regulation.

## **VII. CLIENT DEVICES SHOULD BE PERMITTED TO CONNECT TO OTHER CLIENT DEVICES WHILE INDOORS**

In the *Report and Order*, the Commission generally prohibited client devices from connecting directly to another client device.<sup>64/</sup> This decision reflected the Commission's concern that permitting a client device operating under the control of an access point to authorize the operation of additional client devices could potentially increase the distance between these additional client devices and the access point and increase the potential for harmful interference to fixed service receivers or electronic news gathering operations.<sup>65/</sup> But this decision unnecessarily constrains client devices operating under the control of a low-power indoor access point. There are multiple use cases that require client-to-client indoor connectivity (*e.g.*, screen-casting, wearables, monitoring, etc.) and the current rule already provides for a regulatory

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<sup>64/</sup> 47 C.F.R. §15.407(d)(5).

<sup>65/</sup> *R&O* ¶ 202.

mechanism that can ensure that all client devices remain in close proximity to indoor access points (*i.e.*, indoors). Specifically, client devices are enabled to detect access point transmission in order to initiate probe requests.<sup>66/</sup> Client devices therefore can ensure close proximity to low power access points by receiving their enabling signal. Under this arrangement, client devices will not be able to distance themselves from access points while communicating with each other. In order to clarify that client-to-client communications are permitted, the current rule should be modified as shown below.

- **§ 15.407(d)(5)**: In the 5.925-7.125 GHz band, client devices, except fixed client devices, must operate under the control of a standard power access point, indoor access point or subordinate devices; Subordinate devices must operate under the control of an indoor access point. In all cases, an exception exists for transmitting brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel. Access points and subordinate devices may connect to other access points or subordinate devices. Client devices are permitted to connect ~~prohibited from connecting~~ directly to another client device only while receiving an enabling signal from an indoor access point.

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<sup>66/</sup> *Id.* ¶ 201.

## VIII. CONCLUSION

Wi-Fi Alliance applauds the Commission for its continued leadership in making critically-needed spectrum available for unlicensed use to ease existing congestion and enable innovative next generation uses. It urges the Commission to adopt its proposals to permit indoor and outdoor VLP operations across the entire 6 GHz band, increase the PSD limits for LPI devices, permit the use of mobile and transportable standard power access points, permit higher power fixed point-to-point standard power access points, and allow client-to-client communications.

Respectfully submitted,

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June 29, 2020